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A Thanksgiving Tribute

THAT first Thanksgiving celebration at Plymouth in the fall of 1621 lasted three days. Many of the foods those first colonists shared with their Indian friends were similar in kind to the foods we will eat on our Thanksgiving: wild turkey, goose, duck, and pigeon were there to supplement the five deer the Indians brought. And the colonists and Indians had wild chestnuts, berries, beans and corn which they cultivated, and fish—cod and shad, oysters and clams. There were several other vegetables, too, which were easily stored in the early fall.

But with all of these similarities, that first Thanksgiving dinner was quite different from the meals we will be enjoying. The reason is the foods themselves have changed.

The wild turkeys that Governor Bradford's four marksmen brought in were skinny, puny things compared with the genetically plump, computer-dieted Thanksgiving Toms of today. Through research and selective breeding, the wild turkey has been redesigned from comb to toe. Now, he's an early maturing bird with a voracious appetite. The modern turkey is larger, meatier, and enjoyed while still young, which means he's more tender than his earlier counterpart.

Practically every other dish on that first Thanksgiving table has changed. The corn that was eaten at that first celebration was flint corn. One of the common foods in the colonists' diet, the kernels were smaller than on today's corn, hard, not nearly as tasty, and not as nutritious. The settlers had several other vegetables—pumpkins and squash—but these foods, too, were not what they are today. They were smaller then, less "meaty," and took longer to grow. For each kind of food, there was very limited variety. All in all, that first thankful celebration 357 years ago resembled ours. But many foods common today were unheard of or unavailable to the colonists, and for every food the colonists ate, we now have an assortment of sizes, shapes, colors, varieties and superior strains which the guests at that first Thanksgiving dinner would scarcely have believed possible.

The food we set before us this Thanksgiving and every other day is the product of the careers and lives of thousands of farmers and agricultural scientists. These men and women have produced better and healthier fowl, hardier varieties of wheat and other grains, and pest management systems that protect plants without harming the environment. They have developed faster growing and healthier animals, plants that are resistant to cold, drought, and damaging insects, and an assortment of varieties and strains of practically every plant and animal useful to mankind.

So when we count our blessings this Thanksgiving, we can include one more—for the folks who made it all possible.—*R.W.D.*

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Editor: Howard G. Hass

Assistant Editor: Robert W. Deimel

Contributors to this issue:

Robert A. Barclay, Robert C. Bjork, F. William Brouard, Peggy L. Goodin, G. Ben Hardin, Eriks Likums, Stephen C. Miller, Raymond G. Pierce, Lynn C. Yarris

COVER: Chemically retarding the growth of cotton plants could help combat insects and weeds in cotton fields without reducing cotton yield, according to SEA researchers in Weslaco and Brownsville (0878X970-9). Story begins on page 10.

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Bob S. Bergland, Secretary
U. S. Department of Agriculture

Anson R. Bertrand, Director of
Science and Education

*Right: Candidate sex pheromones are evaluated through olfactometry. Dr. Burkholder records observations as *Trogoderma* released at apex are lured to synthesized compounds entering the olfactometer from glass flasks. Compounds attracting the most insects in this free-choice experiment may be field tested (0578X587-18).*

*Below: In sex pheromone studies, entomologist Ted J. Shapas adjusts an aeration chamber holding female *Trogoderma sternale*. Air, purified by charcoal in the upper section of the column, is drawn downward over the insects; at certain periods of the day the insects release a sex pheromone that is then trapped in the lower section of the column. The collected pheromone is extracted and sent to the State University of New York, Syracuse, to be identified chemically, and synthesized prior to potency challenge and field testing at Madison (0578X586-31).*



Beetle Pests in Stored Food

A PROCEDURE for detecting and killing beetle pests of stored food products may reduce needs for insecticides in homes, food processing plants, warehouses and ships. At the same time, it could reduce losses of food in both developing and developed countries.

Location of several species of beetles can be determined with the aid of a corrugated cardboard trap developed and tested by SEA entomologists at

Madison, Wis. Each trap is baited with a beetle's sex attractant or pheromone and it effectively monitors an area of only a few square meters. Traps can be poised to pinpoint infestations early before they spread, and control measures can be applied when and where they are needed, says SEA entomologist Wendell E. Burkholder.

To test one variation of the idea, Dr. Burkholder and entomologists of the

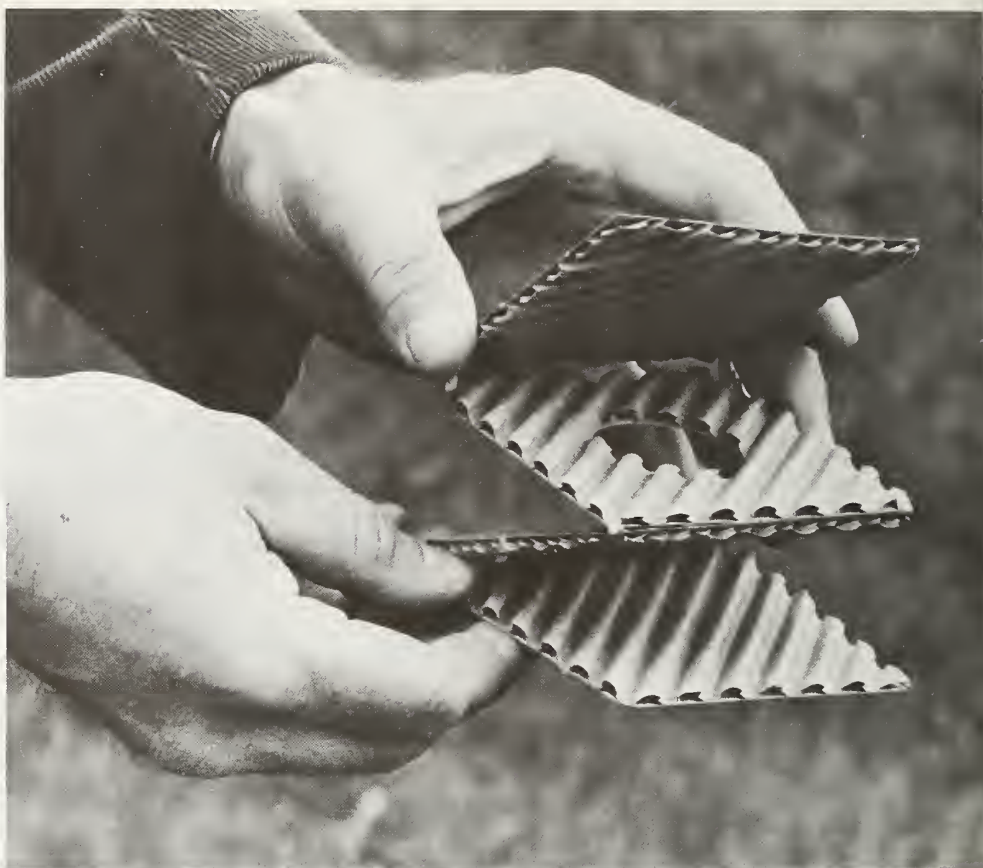
One of several corrugated fiberboard insect trap designs developed by SEA scientists (0578X590-29).

University of Wisconsin, Dr. Ted J. Shapas and Dr. G. Mallory Boush placed cardboard discs treated with *Trogoderma glabrum* beetles' female pheromone in a simulated warehouse where beetle populations were highly concentrated—16 adult pairs per square meter (1.2 square yards). The discs were also treated with spores of *Mattesia trogodermae*, a protozoon that is a slow-killing disease agent of the *Trogoderma* beetles, commonly called dermestids or carpet beetles. Male beetles attempted copulation with the cardboard discs, became contaminated with the disease agent, and later spread the pathogen to female beetles by sexual contact.

Sixty hours after the beetles had been exposed for 48 hours to the discs the researchers brought oviposition sites containing eggs or beetles into the laboratory to complete the study. The beetle population declined by more than 99 percent before a third generation of off-spring could be reared. The research showed that larvae acquired *Mattesia* spores from food contaminated by the adults and from feeding on dead adults.

Because the presence of any insects in food products may spoil whole shipments, use of pheromone-baited traps and insect pathogens will probably be integrated with other measures to keep areas free of pests, says Dr. Burkholder. Facilities that are fumigated for insect eradication may one day be equipped with traps to deter expanding populations. Frequent fumigations would not be a feasible preventative in many situations because of the cost and danger of contaminating expensive commodities by pesticides.

Earlier research indicated that pheromone-baited traps would be useful at least as a survey tool. This research involved placing traps into a cargo terminal, a grain elevator, and a milling com-



pany. Present field studies on integrated controls are being conducted with pheromone-baited traps in combination with either insecticides or insect pathogens.

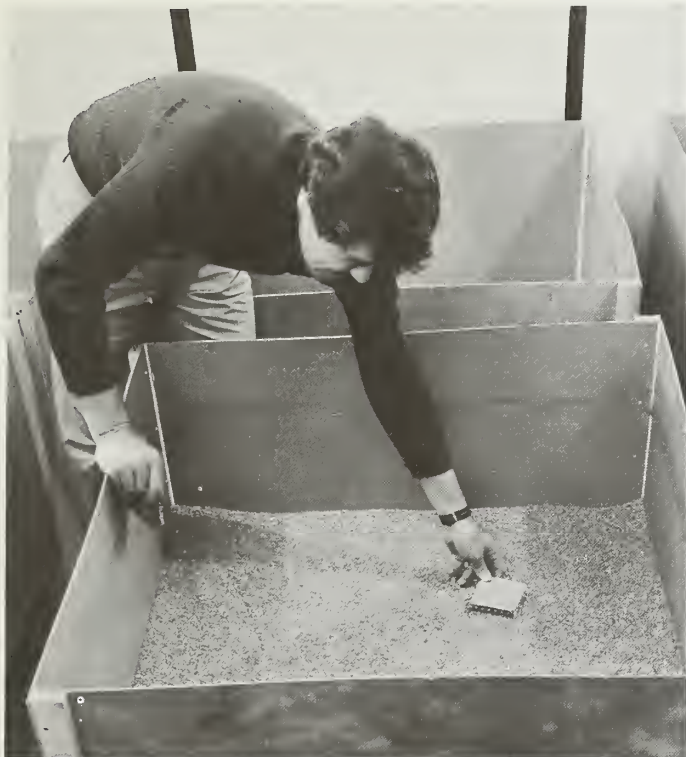
Pheromones of several species of stored-product insects are used in the trapping studies. The pheromones were isolated by Burkholder, graduate students and coworkers at the University of Wisconsin. Several components of the pheromones were identified chemically and synthesized by cooperating chemist Robert M. Silverstein and coworkers of Syracuse University, Syracuse, N.Y.

Chemists at the Max Planck Institute, Germany, cooperated with the scientists at Madison and Syracuse in studies on sex pheromone components of the destructive stored-product insect pest, *Trogoderma granarium*, or khapra beetle. This beetle is closely related to *Trogoderma glabrum* and another dermestid, *Trogoderma variabile*, both of which emit 14-methyl-3-hexadecenal

as a sex pheromone but in differing geometric forms. Geometric forms differ from each other in the three-dimensional configuration of their atoms. The scientists found that khapra beetles emitted a mixture of both geometric forms.

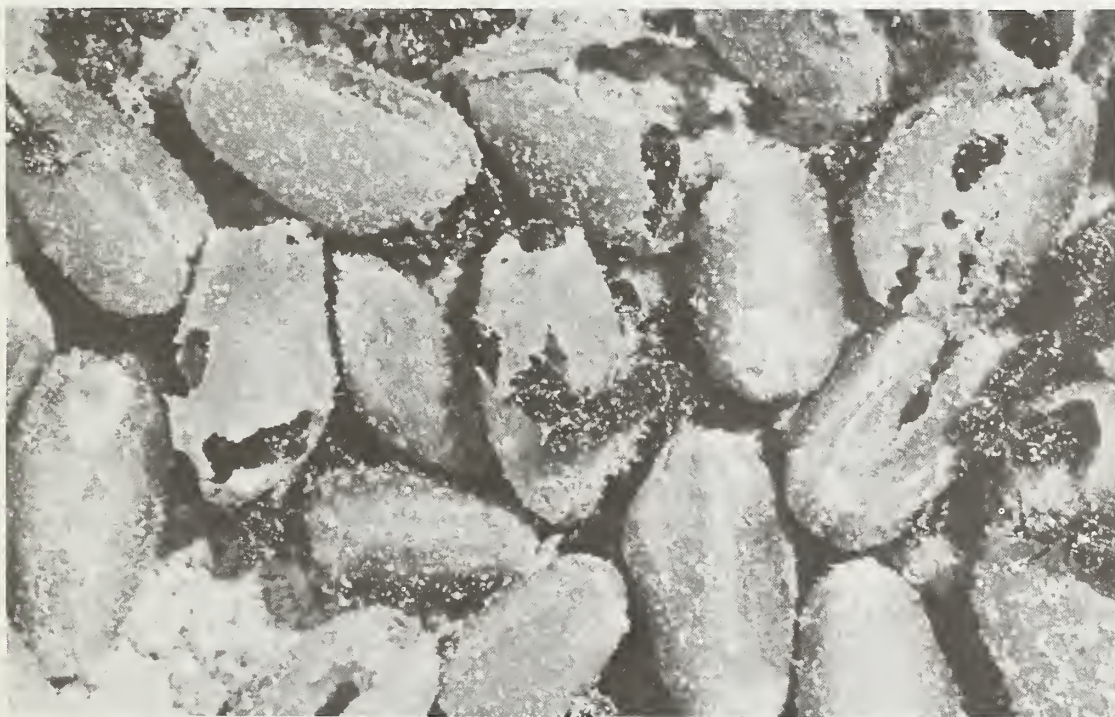
Research utilizing Khapra beetles can not be conducted inside the United States because of quarantine restrictions. Dr. Burkholder says that the knowledge gained through collaborative studies with German scientists may be immensely valuable to the United States, especially if khapra beetles were to be inadvertently introduced into the Nation's ports. Pheromone-baited traps in combination with insecticides or pathogens would help eradicate the insect quickly before it could become established.

Dr. Wendell E. Burkholder is at the Department of Entomology, University of Wisconsin, Madison, WI 53706.—C.B.H.



Above: Dr. Burkholder places pheromone-baited cardboard traps in bins partially filled with lesser grain borer-infested wheat. To simulate a grain warehouse, several of the bins have been installed in a building near the Madison campus (0578X589-20A).

Below: Damaged wheat attests to the destructive ability of the lesser grain borer (0578X588-19).



Above: Dr. Shapas with a sex pheromone baited aerial trap. Designed by researchers at Madison, the trap is used to monitor flying insect populations in and around experimental grain warehouses. Dr. Shapas also reports success in trapping *Trogoderma* in the western states near leafcutter bee colonies where the beetle can be a costly pest of this economically important alfalfa pollinator (0578X590-23).

Insect Resistant Cotton

AS TOBACCO budworms and bollworms become more resistant to insecticides, cotton growers face severe economic hardships. An integrated pest control program which uses a variety of controls reduces the chance that insects will build up tolerance or evade control.

Insect resistant plant varieties are an important part of this program. Cotton varieties that are nectariless, glabrous (hairless) and high in gossypol are less susceptible to insect damage according to researchers Maurice J. Lukefahr of the Cotton Insects Research Laboratory, and Ernesto Salgado, Centro de Investigaciones Agrícolas de Tamaulipas (CIAT).

In a cooperative cotton program with Mexico, scientists have been able to have two crop seasons per year, one in the Rio Grande Valley of Texas and another in the Tampico area of Mexico. This program has permitted critical evaluation of characteristics of wild or feral cottons which might be desirable

for use in some domestic varieties.

The nectariless trait was transferred from *Gossypium tomentosum*, a wild Hawaiian cotton. The greatest value of this characteristic is that it reduces insect populations by depriving *Heliothis* adults of a food source which affects their longevity and fertility. However, *Heliothis* adults are able to feed far from their egg-laying sites because of their strong flight habits, thus reducing somewhat the effectiveness of the nectariless trait.

Glabrous cottons have been developed to ward off insects on commercial cottons. Seventy percent of *Heliothis* eggs are deposited on the growing points of plants which contain 3,000–5,000 epidermal hairs or trichomes per square inch (6.5 square centimeters). The absence of hair results in a 50 percent reduction in egg deposition. Egg reduction in turn means less larvae. Hairless cottons are less subject to cotton flea-hopper populations but more to predation by leafhoppers.

High gossypol cottons produced 50 percent larval mortality in second and third larval stages (instars). Normal cottons have a gossypol content of 0.05 percent in the buds but high gossypol cottons have a 1.2 percent gossypol content. This characteristic also results in a 30 percent reduction of flea hopper and plant bug populations.

In a 1974 test in Tampico, Mexico, *Heliothis* resistant cottons out-yielded the Stoneville 7A variety by three to one. Similarly, in 1975, lines having all three resistant characteristics produced a fourfold increase in seed cotton yields. Tests in 1976 confirmed the previous tests and produced a threefold increase in yield compared to commercial varieties. Resistant cotton varieties are not only highly effective against populations of *Heliothis* but also have high yield as well.

Dr. Maurice J. Lukefahr is with the Cotton Insects Research Laboratory, P.O. Box 1033, Brownsville, TX 78520.—E.L.

Itchgrass Threatens Crops

ITCHGRASS, a weed which resembles johnsongrass, may pose a serious threat to crops throughout the South. Widespread in the tropics, this native of India already infests areas of southern Louisiana and southern Florida.

Experimental simulation of 36 day/night temperature conditions and comparison of those with conditions in June,

July, and August in a wide area of the United States, reveals that itchgrass could pose weed control problems for soybean, corn, and sorghum growers in areas as far north as the upper Midwest.

The experiments reveal that itchgrass could reach 75 to 100 percent of its maximum potential growth in the Gulf Coast States, the lower Midwest, the South Atlantic States and the Southwest. In the Middle Atlantic States, the central Midwest, and the Sacramento Valley of California, itchgrass should attain 50 to 75 percent of its maximum potential growth. In New England, the upper Midwest, and the Pacific Northwest, itchgrass could reach less than 50 percent of its maximum potential growth.

While able to endure a wide variety of temperatures and climatic conditions, itchgrass grows least when night temperatures are below 70° F. (21° C.) or day temperatures below 80° F. (27° C.).

Unless itchgrass control efforts are successful in southern Louisiana and southern Florida, types more tolerant of cool temperatures could develop as itchgrass spreads northward, according to Dr. David T. Patterson, Mr. Charles R. Meyer, and Dr. Paul C. Quimby, Jr., of the Southern Weed Science Laboratory, P.O. Box 225, Stoneville, MS 38776, and Ms. Elizabeth P. Flint of the Botany Department, Duke University, Durham, NC 27706.—E.L.



A jet spray injector instantly "pumps" vaccine into this adult mink at a pressure of 12,000 to 15,000 pounds psi. Injections are most conveniently made in the leg where there is less hair (0678X762-11).

Jet-spray Inoculation of Minks

A SUCCESSFUL mink vaccination program which used a jet-spray injector rather than the standard, needled syringe may have presaged the end of disease contamination problems that occur during mass inoculation of mink and other livestock.

SEA microbiologist David Shen and veterinarian John Gorham, Pullman, Wash., inoculated large numbers of mink and ferrets against a highly contagious distemper virus using the same jet-spray injector that is used to vaccinate people against influenza. Because the jet injector did not puncture the

skin—vaccine is forced into the animals' tissues by air pressure—no disease was passed along from one animal to another via contaminated equipment.

Currently, mink farmers—like other livestock owners—inject their animals with syringes and needles. As large numbers of animals are often involved, it is impractical to use a sterile needle and syringe for each inoculation. Consequently, the chance of contamination is always possible.

For example, one drop of mink blood infected with Aleutian disease virus can

infect 250,000 susceptible mink! The jet injector eliminates this danger.

Drs. Shen and Gorham are among the first to use the jet injector to vaccinate livestock. Their technique should be applicable to other animals and though the present price of the equipment involved is high, the reduced spread of diseases during mass inoculations should more than offset increased inoculation costs.

Dr. David Shen and Dr. John Gorham are located at Room 202, Wegner Hall, Washington State University, Pullman, WA 99164.—L.C.Y.

Pressures Measured on Potato Bin Walls

DESIGN criteria for potato storage bins can be defined better now with knowledge gained about shifting pressures against bin walls. Potatoes stored to depths of 18 feet, for example, exerted bin-wall pressures 3 feet above the floor that were about 60 percent greater than pressures estimated for the 3-foot level by formulae developed a decade ago.

Today's bins typically have a capacity of 1 million pounds (450 metric tons) and some bins hold more than 3 million pounds (1,350 metric tons) of potatoes, says SEA agricultural engineer Earl C. Yaeger of the Red River Valley Potato Research Laboratory in Minnesota.

Potatoes settling against bin walls can damage storage facilities and the commodity. With mounting pressures the walls sometimes give way, spilling potatoes worth thousands of dollars outside to be damaged or destroyed in

freezing weather. Yet, storage facilities can be overdesigned, resulting in construction costs that are unnecessarily high.

To determine how much pressure potato bin walls must withstand, Yaeger and agricultural engineer Lewis A. Schaper installed on the walls hermetically sealed load cells similar to cells used for developing design criteria for grain storage facilities. They monitored changes in pressure at least daily throughout three storage seasons—late September to April—and found that the principal changes in pressures at different heights on the bin walls were similar each year as the seasons progressed.

Pressures on some of the load cells increased at the same time that pressures on other load cells decreased, and shifts from increasing to decreasing pressures at a given level sometimes occurred rapidly. Yaeger said such

shifts may have resulted from developing and collapsing of arches that are sometimes formed by interlocking of potatoes as they come to rest against each other.

Yaeger observed that vibration of the bins by passing trains which are hundreds of feet away may cause pressure changes on the walls, but he has not made detailed studies of the phenomenon. He found that major conditions that affected pressure were depth of the potato pile, width of the storage bin, length of storage time, and coefficients of friction (the inherent tendencies of potatoes to resist sliding against each other or the walls).

Potatoes that are wet have measurably different coefficients of friction than do dry potatoes. In studies now underway, Yaeger is monitoring pressures against bins where potatoes were wetted with fungicides as they went into storage. He will be studying pressures against walls of bins that are wider at the bottom than at the top.

In his research, Yaeger is measuring vertical pressures against the floors as well as lateral pressures against the walls. Vertical pressure information is needed for bin design purposes as much as lateral pressure information, he said, because the relationships of these pressures are used in mathematical engineering analyses. The information may also be useful for designing pallet boxes and floor ventilation ducts.

Vertical pressure information also one day may be used to estimate pressure flattening of potatoes at the bottom of storage bins. Potatoes that are flattened at points of contact with other potatoes and the floor often sell at a lower grade than unaffected potatoes from the same bin. When flattened potatoes are moved around, they are more susceptible to bruising or black spot.

Mr. Earl C. Yaeger is at the Red River Valley Potato Research Laboratory, 315 Ninth Avenue South, East Grand Forks, MN 56721.—G.B.H.

Coated Seed Shows no Advantage

LEGUME seeds coated with nitrogen fixation bacteria showed no significant advantages in establishing seedlings, increasing nodulation on plant roots, or improving forage yields when compared with uncoated seeds in tests conducted at several Minnesota locations in the 1976-77 crop year.

SEA research geneticist Donald K. Barnes, stationed at the University of Minnesota, tested alfalfa and red clover seeds that had been coated by commercial seed companies. The treated and untreated seeds, both from the same lot, were compared in plantings at Crookston, Grand Rapids, Lamberton, Rosemount, St. Paul, and Waseca.

Advertisements for coated seed have reported that coating aids germination and emergence under most conditions; provides uniform size and weight for even seed distribution; assures more uniform stand establishment, usually with less seed per acre (.4 hectares); and creates an optimum environment for *Rhizobium* viability which leads to proper nodulation and nitrogen production.

Coated seed usually means seed that has been coated with lime and nitrogen fixing *Rhizobium*, although nutrients, fungicides and insecticides are sometimes included. Use of coatings on alfalfa is a relatively new development, Dr. Barnes says.

Two seeding rates were used in the tests, Dr. Barnes says. One test rate was based on weight of seed. Because coated seed weighs more than uncoated seed, more seeds were planted per acre in the

uncoated plots. In the other seeding rate, an equal number of seeds were planted per acre.

"Yield results were not significantly different," says Dr. Barnes, "During the first production year, alfalfa planted by weight with uncoated seed yielded an average of 5.05 tons (4.54 metric tons) of dry matter per acre. Plots planted by weight with the two seed lots of commercially coated seeds, averaged 4.86 and 5.13 tons per acre (4.37 and 4.61 metric tons per .4 hectare).

The plots planted on the basis of the same number of seeds per acre averaged 4.02 tons (3.61 metric tons) per acre with uncoated seed, and 4.00 and 4.15 tons (3.6 and 3.73 metric tons) on plots planted with the two commercially coated seed lots.

Tests of red clover seed, planted on the basis of equal number of seeds per acre, produced results similar to the alfalfa tests. Plots planted with uncoated seed averaged 2.88 tons per acre (2.59 metric tons per .4 hectare). Plots planted with the two commercially coated seed lots averaged 2.56 and 2.79 tons per acre (2.30 and 2.51 metric tons per .4 hectare).

"The lack of advantage for coated

seed was somewhat surprising, because studies in New Zealand have reported an advantage for coated seed under drought conditions," Dr. Barnes says. "A drought in Minnesota during establishment of the 1976 plantings was extremely severe. Although the seed was drilled about three-quarter inches (1.87 centimeters) deep, it laid ungerminated in several plantings for more than a month."

"So far, our data show that coated seed has very little effect on alfalfa establishment, nodulation, and yield when used in non-acid soils. There may be situations or conditions, such as sod seeding, in which the use of coated seed would be helpful. More tests are needed. Additional seed coating technology, such as increasing the numbers of *Rhizobium* per seed and the development of new seed coating additives, might be helpful," Dr. Barnes says.

"In general, the potential value of seed coating remains to be tested," he added.

Dr. Donald K. Barnes is at Room 402, Agronomy Bldg., University of Minnesota, St. Paul, MN 55108.—*R.C.P.*

Right: Dr. Gausman measures the height of a cotton plant treated with a growth regulator (0878X973-26A).



Left: Dr. Helmut Walter (left), a visiting plant scientist from West Germany, and Dr. Gausman measure CO_2 absorption by a cotton plant leaf. Absorption of CO_2 is less in plants treated with a growth regulator (0878X973-22A).



Growth Regulators for Cotton

CHEMICAL growth regulators promise cotton farmers a new management tool for controlling undesirable vegetative growth and for reducing late season and overwintering insect populations. Two types of growth regulators are being studied: growth retardants to control plant height and to increase boll retention, and plant terminators to induce shedding of squares (immature green bolls) that provide the food supply to sustain late season insect populations.

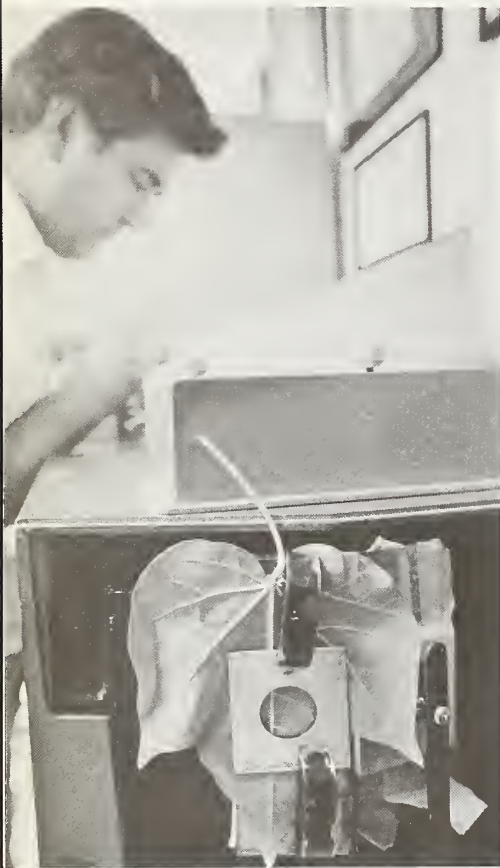
A less dense plant canopy provides

fewer hiding places for cotton insects. A compact plant that allows more light penetration and air movement in the canopy makes insecticide applications more effective, reduces boll rot losses, decreases the possibility of lodging and provides greater harvest efficiency.

1. 1-dimethyl-piperidinium chloride (DPC) has been effective as a growth retardant and boll set inducer for cotton. Application of DPC in field studies resulted in a significant reduction in plant height, and that reduction was obtained within 10 days after treat-

ment. Lateral branch and main stem internodes were shorter than before treatment. There were no significant differences, according to L. Neal Namken and Harold W. Gausman, in time of bloom, total yield, boll size, seed weight or lint quality due to DPC treatment. None of the growth regulators that are being tested are now registered for use on cotton.

Researchers using chemical growth terminators in short season cotton production in south Texas are determining if the removal of late-season squares by



Above: Light reflection tests can reveal changes in leaf development caused by a plant growth regulator. By applying the same principles of infra-red photography used in remote sensing, biological laboratory technician Romeo Rodriguez measures the ratio of near infra-red light to visible light as reflected from this cotton plant leaf. Plants treated with growth regulators produced thicker leaves that reflected more light near the infra-red end of the spectrum, thus indicating an effect on photosynthetic activity (0878X972-3A).

Right: On a test field of cotton plants sprayed with a growth regulator, Dr. Wolfenbarger checks traps for boll weevils. The traps enable Dr. Wolfenbarger to monitor the migration of boll weevils from treated to untreated (and therefore more "hospitable") fields (0878X971-1A).

chemical termination might be an effective pest-management practice for reducing late-season boll weevil and tobacco budworm populations. Preliminary results from these studies by Dan A. Wolfenbarger and James W. Davis indicate that chemical termination applications applied 40 to 45 days after first bloom significantly reduced the number of boll weevils emerging from squares and bolls without reducing yields.

The potential benefits of using growth-regulating chemicals to eliminate late season squares, after boll production has reached the level required to provide desired yields, lies primarily in reduced insecticide applications. The benefits may be manifested in reduced insecticide applications during the current and following season due to reduced populations of overwintering pink bollworms or boll weevils. A delay in population buildup during the spring following chemical termination applications has been difficult to demonstrate. Pink bollworm moths and boll weevils

are capable of moving long distances after they emerge in the spring and establishing overwintering populations in test fields. Researchers will not be able to determine the full potential of this type of pest-management practice until large areas can be uniformly treated for several years.

Although the growth regulators being tested are not currently registered for use on cotton, the manufacturer of DPC already has an experimental use permit. This chemical may be available to farmers within the next 2 or 3 years. Registration of plant terminators is still further down the road. The effectiveness of growth regulators appears promising, despite the fact that they are at the same stage of development that herbicides were 20 to 25 years ago.

Drs. L. Neal Namken and Harold W. Gausman can be contacted at P.O. Box 267, Weslaco, TX 78596, while Dr. Dan A. Wolfenbarger and Mr. James W. Davis may be reached at P.O. Box 1033, Brownsville, TX 78520.—E.L.



Preserving Nutrients in Peeled Tomatoes

THE advent of nutritional labeling has made the nutritional content of processed foods a vital question to all consumers. Methods of treatment during processing may affect the nutritional content of processed foods.

Researchers determined the effect of different peeling methods—hot water,

lye, and liquid nitrogen—on the nutritional content of canned Chico III tomatoes. Each lot of tomatoes was divided into three batches for peeling. The first batch of tomatoes was submerged 45 seconds in boiling water, then cooled in tap water and peeled by hand. The second batch was peeled with lye. The tomatoes were submerged 30 seconds in a 195° F. (91° C.), 20 percent lye solution, then cooled in tap water. The remaining peel was removed by hand. The third batch was peeled with liquid nitrogen. The tomatoes were dipped for 23 seconds in liquid nitrogen, then thawed for 30 seconds in 80° F. (27° C.) water. The skin sack was then manually slit and peeled. Two control samples consisting of 36 each of fresh unpeeled and fresh hand-peeled tomatoes were used for comparison.

Nutritional composition differed the most between fresh and canned tomatoes regardless of the peeling method

used. Fresh tomatoes had a lower pH and a higher acidity than canned tomatoes. In canned tomatoes the acidity was slightly lower in lye peeled than in water or liquid nitrogen peeled tomatoes. Niacin levels were a little lower in water peeled than in lye or liquid nitrogen peeled tomatoes. There were no appreciable differences in moisture, pH, percent of soluble solids, ash, fat, fiber, iron, calcium, protein, vitamin C, vitamin A, thiamine, riboflavin, total carbohydrate, or caloric value which could be attributed to peeling method. According to Mr. Guadalupe Saldana, Mr. Thomas S. Stephens (retired), Mr. Robert Meyer, and Mr. Bruce J. Lime of the Food Crops Utilization Research Laboratory, P.O. Box 388, Weslaco, TX 78596, canners can peel Chico III tomatoes with either hot water, lye, or liquid nitrogen without appreciably altering the composition of tomato nutrients.—*E.L.*

How Much Rain Does a Rain Gauge Gauge

IN THE centuries-old practice of measuring rainfall, the 200-year-old discovery of the pit gauge remains the most accurate and expedient way to measure precipitation, a recent SEA study showed.

Rainfall records have been kept for thousands of years with surprisingly little difference between measurement techniques used then and now—rainfall is still collected by placing a vessel of prescribed dimensions and shape on the ground. And down through the ages the question has always been: "How much rain does a rain gauge gauge?"

Since the 1800's, wind has been identified as a chief cause of rain gauge

error. Even before then, people were placing rain gauges in pits so that gauge orifices were at ground level and wind influences were eliminated. However, there were concerns that snow would blanket pit gauges or that pit gauges would be subjected to excessive splashings, so they were raised above the ground and mounted with windshields of myriad descriptions.

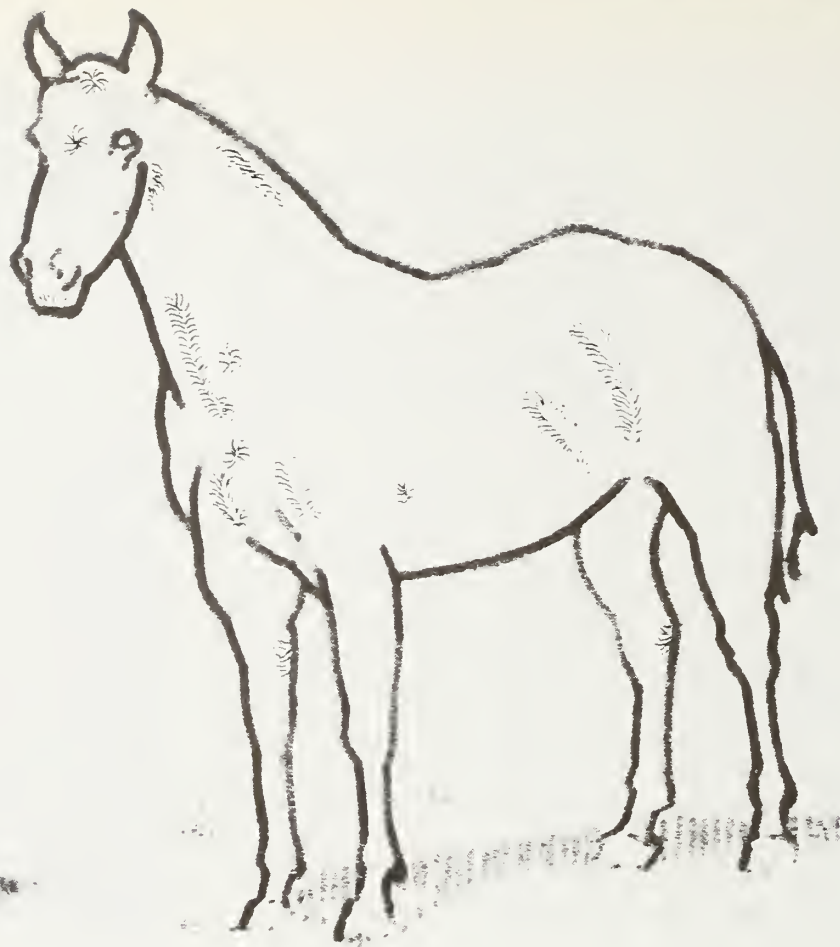
To answer how much rain a rain gauge gauged and determine the most accurate way to measure rainfall, SEA hydraulic engineer Earl L. Neff, Sidney, Mont., studied rainfall data. The data that he studied was collected at four different locations and times through-

out the Pacific Northwest.

He found that rain gauges exposed to the wind catch 5 to 15 percent less rain than pit gauges and that errors for individual storms range from 0 to 75 percent, depending upon the storm's wind velocity. Neff says that the error most often made in a rain gauge reading is the assumption that the reading is completely accurate.

How much rain does a rain gauge gauge? Seldom as much as falls from the sky.

Mr. Earl Neff is located at the Northern Plains Soil and Water Research Center, P.O. Box 1109, Sidney, MT 59270.—*L.C.Y.*



A Horse of a Different Cowlick

A QUICK and convenient method of identifying a horse by the hair whorl on the front of its head offers promise for breed registries, insurance companies and the horse-owning public.

With the millions of dollars annually involved in horse racing, the temptation for a dishonest person to "counterfeit" an animal is sometimes too much to resist. For this, and other less dramatic reasons, the horse industry needs a permanent, unalterable system of identifying individual animals.

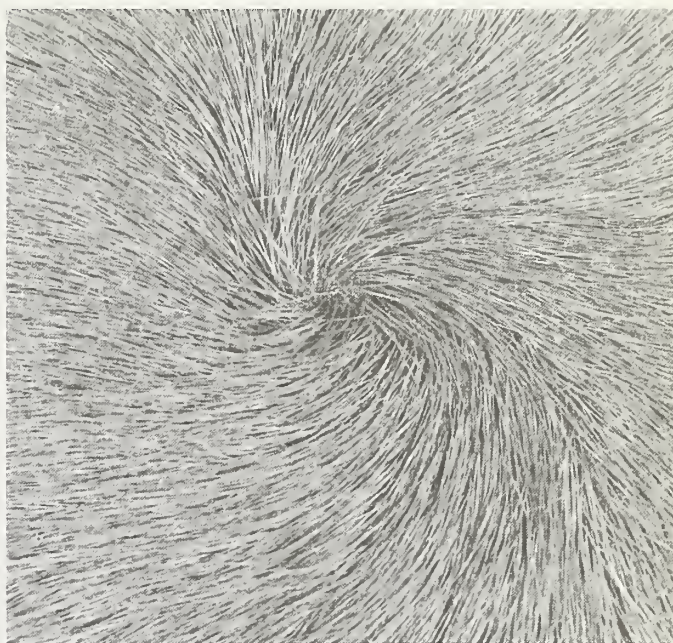
SEA veterinarian R. Keith Farrell, along with veterinarian Mike Conaway of Washington State University, Pullman, Wash., believes that disturbances in a horse's hair stream—called trichoglyphs—can be used to identify horses, much as fingerprints are used to identify humans.

The most prominent type of trichoglyph is the hair whorl. It is created

while the animal is still an embryo and when skin is stretched around prominences. The skin's plane of stretch determines the direction of the hair and, once the whorl is established, its pattern and direction are set for life.

Farrell and Conaway have devised a process that converts a horse's frontal hair whorl (which corresponds to a person's cowlick) to a permanent record that can be filed as information retrievable by either computers or humans. Their process involves taking a negative mold of the hair whorl, using a clay disc, and from that mold, making a positive cast. This cast provides an exact duplicate of the whorl that can be inked and printed onto any document where identification is required.

The horse's frontal hair whorl theoretically meets all criteria required by the horse industry to serve as the sole identifying characteristic of an individ-



Above: Dr. Farrell presses a clay molding disc against the "A-2" category whorl cowlick of a thoroughbred—one of thousands to be tested in a statistical analysis of the research (0678X758-8A). Above right: Closeup of a clockwise A-2 whorl showing two dominant hair streams. Usually located between the eyes, this particular type of whorl may be theoretically sufficient in itself for horse identification, but realistically should be used in conjunction with other whorls and other identifying marks such as freeze brands (0678X758-21A). Right: The hair whorl impression on this clay disc becomes the mold for a rubber-plastic cast with which the unique pattern can be stamped onto identification papers and other documents (0678X759-5A).

ual animal—no two horses have identical whorls; there is a high degree of variability in the type, number and location of whorls on every animal; and the whorls can't be altered without the alteration being easily detected.

The term trichoglyph comes from the Greek words, "trico," (hair) and "glyph," (carving). Using trichoglyphs

such as hair whorls to identify animals is an accepted practice for livestock in the Far East where tattooing and branding are forbidden. Trichoglyphs are also being tested as a means of identifying seals to learn why their numbers are decreasing.

The system is not yet proven for horses, however. Drs. Farrell and Con-

way say they need to continue to study the hair whorl patterns of horses to make certain that horse trichoglyphs do not change in location or appearance with age.

Dr. R. Keith Farrell is located in Room 202, Wegner Hall, Washington State University, Pullman, WA 99164.—L.C.Y.

Intermittent Sprayer Reduces Pesticides

ONE WAY to reduce the amount of pesticides applied on fruit and vegetable row crops is to activate the sprayer only when it is over a plant, spraying only the plant, not the entire surface of the field or the row.

That is the approach SEA scientists at Wooster, Ohio, and Yakima, Wash., are taking in an effort to reduce the cost and volume of pesticides applied to high-value fruit and vegetable crops.

At Wooster, two automatic intermittent sprayers, one electrically operated and the other operated by air, were compared with a continuous sprayer for control of the cabbage looper and imported cabbage worm on cabbage plants.

The air operated unit uses 31 percent less insecticide than the continuous sprayer and is equally effective in control of pests and feeding damage. The electrically operated unit uses 42 percent less material but does not control pests as well, probably because of synchronization problems of the spraying unit. The researchers believe improved timing will improve plant coverage and optimize the efficiency of both units.

Agricultural engineer Donald L. Reichard constructed two types of intermittent sprayers and one continuous sprayer from conventional, commonly available materials.

All components used in the intermittent operation of both systems are small, inexpensive, and easily obtainable, and they are designed for reliable operation through millions of cycles at very fast response times, Reichard says.

All three units were designed for a three-point tractor hitch, he said, and

all delivered spray at the same pressure and through the same type nozzle. Two nozzles were used per row when plants were small, and a third nozzle was added for later applications. Both intermittent units utilized spring steel feeler wires to sense the plants and trigger the sprays.

Cabbage was selected for 1977 tests because it is a long season crop, has several insect pests, increases in size rapidly over the growing season, and can be rated visually for insect damage.

Entomologist T. L. Ladd, of USDA's Japanese Beetle Research Laboratory at Wooster, set out cabbage transplants on May 17, and made weekly pesticide applications from June 5 to July 20. A second planting was made June 30, and sprayed weekly until August 17.

"We applied malathion, a relatively poor insecticide for control of cabbage looper and imported cabbage worms, at a rate of only 60 percent of that normally recommended, to ensure that infestations in the first planting would be large enough for evaluation," Dr. Ladd said.

For the second planting, malathion was applied at the full rate for several weeks, but then replaced by methomyl, a highly effective material for the control of cabbage pests.

Feeler wire sensors were adjusted as plants increased in size to determine the best configurations for detecting pests.

"We measured the amount of chemical used and took counts of the insect pests and insect feeding damage each week," Dr. Ladd says. "Our studies show that the air operated intermittent sprayer used 31 percent less pesticide during the season and controlled insect damage just as well as the continuous sprayer."

"If we assume 8 weekly applications the savings in pesticide costs per acre would be about \$10.50 and would soon

offset the cost of an intermittent sprayer," Mr. Reichard says. "In addition, contamination of the environment would be reduced in proportion to the amount of pesticide saved."

At Yakima, agricultural engineer Peter A. Boving has been working on a modulated infrared electric eye system. Sunlight does not interfere with the system because the sprayer is activated only when a plant interrupts the modulated infrared light beam. Modulation is used to prevent infrared radiation from sunlight interfering with the sensor reception.

Dr. Ladd and Mr. Reichard will compare electric eye, air operated, and continuous spraying systems during the 1978 season. They will use peppers and cauliflower as well as cabbages in this year's tests.

Mr. Boving's work is directed at treating sugarbeets which are attacked by insects from the time they emerge, resulting in reduced sugar yield and an increase in sugar extraction costs. Treatment of emerging seedlings for protection from insects helps to maintain yields and keep down production costs.

Boving says, "Using broadcast techniques to treat seedlings with pesticides is very inefficient when the ground coverage of the crop may be only 10 percent. Spraying only the crown of each plant would result in savings in material applied, increased application efficiencies, reduced costs to the grower, better protection from insects, reduced harm to the biosphere, and reduced soil compaction caused by heavy equipment loads."

Mr. Reichard points out that many growers now use air blast sprayers, but increasing costs of chemicals will increase the importance of reducing the amount of chemical applied, making the row-type intermittent sprayer increasingly practical.

Dr. Thyrl L. Ladd, Jr. and Mr. Donald L. Reichard are with the Ohio Agricultural Research and Development Center, Wooster, OH 44691.—*G.B.H.*

Why Blueberries Turn Tough

EVERY year for 10 years—from 1966 through 1975—Americans ate and exported an average of 30,919,400 pounds (13,913 metric tons) of frozen blueberries; they are becoming an increasingly important cash crop in developing rural areas of the South (AGR. RES., Dec., 1977, pp. 12-13).

But in spite of the blueberry's growing popularity, there is a problem in its texture if the berry is frozen. Woodiness or grittiness in frozen berries occurs when they are stored for as long as 6 months at -10° F. (-24° C.) and 0 degrees F. (-18° C.). Blueberries are temperature dependent, and the rate of freezing influences both texture and color.

Plant physiologist Elias D. Dekazos reports a significant improvement in rabbiteye blueberries that were coated with a mixture of cellulose gum, gum tragacanth, and citric acid, and stored at -30° F. (-34° C.). The treatment resulted in a marketable product even after 21 months, using cultivars 'Tifblue,' 'Woodard,' and 'Briteblue.'

"This can be of great significance for blueberry processing. These berries were like fresh berries. They retained their texture, appearance, and natural waxy bloom," said Dr. Dekazos.

In the Russell Research Center's Horticultural Crops Utilization and Marketing Laboratory, representative samples of berries were

weighed, sealed in polyethylene bags, placed in pint containers and stored at 0° F., -10° F., and -30° F. (-18° , -24° and -34° C., respectively). Berries were also frozen in liquid nitrogen, in Freon 12, and by air-blast.

Berries frozen in liquid nitrogen, Freon 12, or in the coating mixture and then stored at -30° F. (-34° C.) all resembled fresh berries, but the coating mixture yielded the best results.

During the mixing of the berries with the coating mixture, the cellulose gum is absorbed within the pores of the fruit to maintain firmness and natural color. Tragacanth improved the dispersion of the cellulose gum onto the berries, and the citric acid helped to preserve the fruit. The water-binding action of edible gums prevents an undesirable graining texture and the growth of ice crystals.

Dr. Dekazos' investigations also showed, for the first time, the actual cause of woodiness and grittiness. Certain parenchymatous cells—living cells capable of division—differentiated into sclereids or hardened, thick-walled cell tissue. The distribution of the sclereids was at random in the fleshy fruit, especially near the area of the seeds and the inner layer of the walls of the plant ovary.

Dr. Elias D. Dekazos is with the Russell Research Center, P.O. Box 5677, Athens, GA 30604.—*P.L.G.*

Additive May Increase Protein in Corn



Above: Earlier studies on nitrapyrin revealed that use of this fertilizer additive reduced certain plant diseases. Here, Dr. Warren examines growth of fungal pathogens to be used for inducing stalk rot disease in test plots of corn (0778W916-5A).

A FERTILIZER additive that was developed to preserve the availability of nitrogen for plants, nitrapyrin, may increase protein production in corn. This additive has increased production of some protein components more than others.

These observations were made by a team of scientists who earlier found that nitrapyrin reduced the severity of several plant diseases—stalk rots in corn and the root rot take-all in wheat. SEA plant pathologist Herman L. War-

ren and his colleagues of the Purdue University Agricultural Experiment Station, West Lafayette, Ind., noted in their earlier study that nitrapyrin at times dramatically increased grain yields.

Nitrapyrin is a nitrification inhibitor—it slows the process in which nitrogen in the ammonium form is converted to the nitrate form. Because nitrates from fall-applied fertilizers may leach from the soil or be converted to atmospheric nitrogen gas before they can be utilized by the next season's crop, Dr. Warren says, slowing formation of nitrates can save dollars invested in fertilizer.

In their latest study, the scientists found that corn grown with high or normal rates of stabilized ammonium fertilizer generally produced both

higher yields and higher percentages of protein than did corn produced with unstabilized fertilizer.

The researchers also found that the endosperm portion of corn kernels grown with stabilized fertilizer contained a higher percentage of zein (an alcohol-soluble protein) than did endosperm of corn grown with unstabilized fertilizer. Zein is poor in nutritional quality for humans and one-stomach animals such as pigs. This protein contains little of the essential amino acid, lysine.

If the greater proportion of low-quality protein seems disappointing, Dr. Warren says, the cloud of bad news has a silver lining. The corn grown with stabilized fertilizer had greater kernel weight and germ size. Increased protein in the larger germ consisted of nutri-

tionally desirable types of proteins called albumins and globulins.

While proportions of protein types in sections of the kernels differed according to nitrogen fertilizer applications, the various amino acids were produced in about the same proportions in the complete kernels, Dr. Warren says.

Zein, which is rich in the amino acids glutamine, leucine, proline, alanine and asparagine, may serve as a nitrogen sink, or storehouse, to prevent accumulation of toxic levels of ammonium and free amides in other parts of the plant, says Dr. Warren. It also forms a matrix for storage of starch granules in the endosperm.

Dr. Warren and his colleagues have hypothesized that, when the nitrogen sink is abundant, high rates of ammonium fertilizer speed the movement of sugars or photosynthates from leaves to the kernels. This movement of photosynthates may promote starch production for increased corn yields.

Some corn hybrids are genetically programmed to produce more zein than others.

Members of the research team of Purdue University included Biochemical geneticist Dr. Charles Y. Tsai and plant pathologist Dr. Don M. Huber.

Nitrapyrin may greatly improve the recovery of nitrogen fertilizer by the nation's corn, cotton, wheat, and sorghum crops under wet soil conditions. The manufacture of a ton of the nitrogen fertilizer, anhydrous ammonia, requires 40,000 cubic feet of natural gas (not 400,000 cubic feet as was incorrectly stated in the August 1978 issue). Corn and wheat alone, which consume over half of the total nitrogen in fertilizers offer the greatest potential in benefits through higher yields with inhibition of nitrification.

Dr. Herman L. Warren is at Room I-308 Lilly Hall, Life Sciences Building, Purdue University, West Lafayette, IN 47907.—G.B.H.

Fertilizer companies sell nitrapyrin as a premix ingredient in anhydrous ammonia, liquid nitrogen, or dry ammonium-type fertilizers for incorporation into soils used in corn, cotton, wheat, or sorghum production.

The product has been marketed in increasingly larger geographic areas since 1974. It is now applied extensively by farmers in pockets of the Midwest, Southeast, South, Great Plains, West, and Pacific Northwest.

Numerous methods can be employed to incorporate nitrapyrin into fertilizer and the soil. When anhydrous ammonia is used, for example, nitrapyrin may be metered into ammonia nurse tanks at the dealer location or farmers may use their own pumping equipment for metering it through their fertilizer applicators.

Regardless of the type of fertilizer used, nitrapyrin must be incorporated into the soil where it can act as an antibacterial agent against soil organisms that rapidly convert ammonium nitrogen to nitrates.

Nitrapyrin is federally registered for use with specific crops at rates of one-fourth to one-half pound per acre (.28 to .56 kilograms per hectare).



Biological laboratory technician Marcella Zorilla transfers fungal cultures to build up inoculum used in disease-resistance tests for nitrapyrin (077W916-28A).



AGRISEARCH NOTES

Short Sugarcane

COMMERCIAL sugarcane fields in Louisiana are routinely planted with whole stalk seed cane. The seed cane is machine cut with soldier harvesters, loaded into wagons and then distributed to the furrow either by hand or by machine. Mechanical planters have not been completely accepted because of the difficulty growers have in obtaining a uniform distribution in the furrow and in planting crooked seed cane. These problems could be avoided with short seed pieces, but it is widely believed and supported by earlier tests that plantings of short seed pieces would not survive the Louisiana winter.

The results of recent tests indicate that short seed pieces can survive the winter and produce acceptable stands. These results are based on six experiments conducted over 4 years using five varieties. The results indicate that short seed pieces 11.2–19.2 inches long (28–48 cm) planted at comparable rates as whole stalks 60–74 inches long (150–185 cm) give comparable yields when the seed pieces are either hand cut or cut by an Australian planter. Short seed pieces (35 cm average length) cut by combine harvester do not yield as well as whole stalks, apparently because of damage done to the seed piece by the harvester.

The tests were conducted by Dr. Gerd T. A. Benda, Mr. Hugh P. Fanguy, Dr. James E. Irvine, and Dr. Richard D. Breaux at the U.S. Sugarcane Field Laboratory, P.O. Box 470, Houma, LA 70361.—*E.L.*

Computer Simulates Weed Growth

SCIENTISTS now have a computer programmed to predict responses of weeds to various environmental conditions.

SEA agronomist Marvin M. Schreiber and his colleagues at Purdue University, West Lafayette, Ind., chose to simulate growth of the weeds robust white foxtail and robust purple foxtail in a computerized program or model. These weeds have become serious crop pests in eastern and midwestern States during the last two decades.

The model, named SETSIM, is the first weed growth model and it may serve as a forerunner of models for other weeds. Dr. Schreiber says such models some day may help farmers determine when to apply herbicides most effectively. The models also may predict spread of weed infestations in new geographic areas.

Together with crop models, weed models may be used eventually to estimate yield reductions and harvest

losses attributable to weeds. Insect and disease models also could be incorporated into an overall body of computerized knowledge to improve integrated biological, chemical and cultural pest controls.

Dr. Schreiber says that further refinement of the new weed growth model will help students and researchers improve their understanding of weed physiology as they compare simulated predictions with actual observations in the field.

Dr. Marvin M. Schreiber's address is Lilly Hall of Life Sciences Building, Room G-315, Purdue University, W. Lafayette, IN 47907.—*G.B.H.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or

other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

